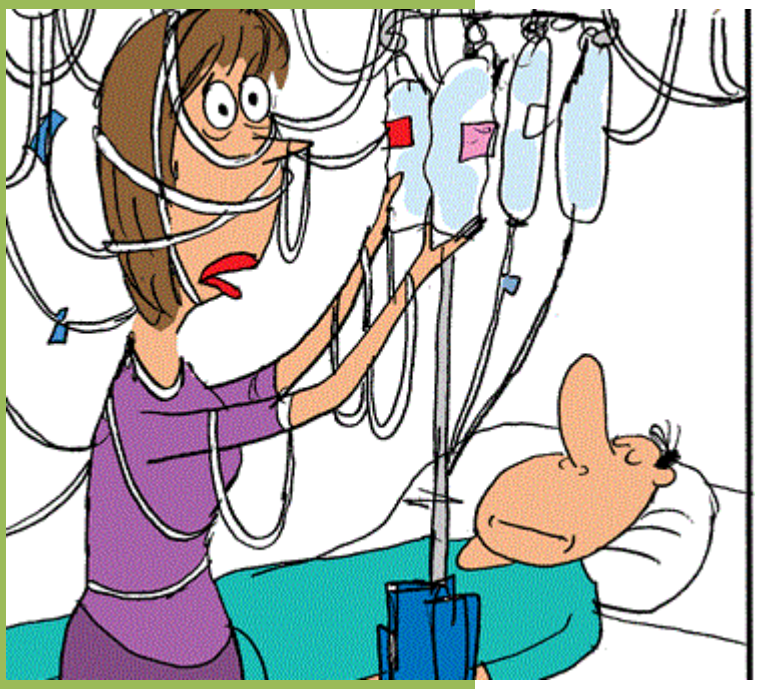
Drug Infusions in ICU made ridiculously simple



Asmaa M. Ghourab

Clinical Pharmacist

Drug Infusions in ICU made ridiculously simple

"You fast guide for drug infusions in ICU"

Asmaa M. Ghourab

Clinical Pharmacist

Dekernes General Hospital, Dakahlya , Egypt

" June 2016"

Revised by

Mahmoud Yaseen

Critical care specialist

Contents :

Adrenaline

<table>
<tr><td>Strength</td><td colspan="2">1mg / 1ml</td></tr>
<tr><td>Compatibility</td><td colspan="2">NS, D5W.

don’t mix with sodium bicarbonate</td></tr>
<tr><td>Uses</td><td>Dose</td><td>Infusion rate</td></tr>
<tr><td></td><td>0.04–1 mcg/kg/minute

-N.B. doses <0.3 mcg/kg/minute generally produce beta-adrenergic effects
-higher doses (>0.3 mcg/kg/minute) generally produce alpha-adrenergic vasoconstriction</td><td>-5 amp * 50 ml →1.5-42 ml/hr.

(very high doses for refractory hypotension)

*NB: 1 ml =100 mcg</td></tr>
<tr><td>Stability</td><td colspan="2">• 24 hr.

• Epinephrine is sensitive to light and air; protection from light is recommended.
• Oxidation turns drug pink, then a brown color;
• Solutions should not be used if they are discolored or contain a precipitate.</td></tr>
<tr><td>Precautions</td><td colspan="2">❖ Central line required for administration</td></tr>
</table>

Alteplase (tPA)

Strength		**20 mg (after reconstitution 1mg/ml)**	
Compatibility		**NS, sterile water for injection**	
Uses		**Dose**	**Infusion rate**
	STEMI	-100 mg over 1.5 hour. (administered as a 15 mg I.V. bolus over 1-2 minutes followed by infusions of 50 mg over 30 minutes, then 35 mg over 1 hour)	**15 ml I.V. bolus over 1-2 minutes then 50 ml over 30 minutes, then 35 ml over 1 hour**
	PE	-100 mg over 2 hours. (administered as a 10 mg bolus followed by 90 mg over 2 hours)	**10 ml bolus then 90 ml over 2 hours**
	acute ischemic stroke	-0.09 mg/kg (max 9mg) as an I.V. bolus over 1 minute, followed by 0.81 mg/kg (max 81mg) as a continuous infusion over 60 minutes.	**9ml bolus over 1 minute then 81ml over 60 minutes**
	peripheral arterial occlusion (intra-arterial) (Unlabeled)	-*Weight-based regimen:* 0.001-0.02 mg/kg/hour (maximum dose: 2 mg/hour) OR -*Fixed-dose regimen:* 0.12-2 mg/hour Duration :-6-48 hours according to size and allocation of thrombus	**.12-2 ml/hour for 6-48 hours**
	prosthetic valve thrombosis (Unlabeled Use)	-*High-dose regimen:* Load with 10 mg, followed by 90 mg over 90-180 minutes (without heparin during infusion) . -*Low-dose regimen (preferred for very small adults):* Load with 20 mg, followed by 10 mg/hour for 3 hours (without heparin during infusion) .	**-10 ml bolus, then 90 mg over 90-180 minutes OR -For Low weight adult →20 ml, then 10 ml/hour for 3 hours**
Stability		• **Use within 8 hrs. (at temp 2-30 C),** • **Discard unused portion**	
Precautions		❖ **Reconstitute the powder with sterile water for injection to give 1mg/ml** ❖ **→let stand undisrupted for several minutes (to allow large bubbles to dissipate)** ❖ **→Mix by gentle swirling or slow inversion ,Do Not shake.** ***NB:-May be further diluted with equal volume of NS to yield →.5mg/ml**	

Aminophylline

Strength	**125 mg /5 ml**	
Compatibility	**D_5W, NS**	
Uses	**Dose**	**Infusion rate**
	-5mg/kg then .5 mg /kg/hr (use lower infusion rates i.e.<21mg/hr FOR :- pt >60y / Cor pulmonale / cardiac decompensation / liver dysfunction)	**3 amp * 350ml NS over 30 minutes then 1amp*125 ml Ns →35 ml/hr**
Stability	• **Use prepared infusions immediately; change every 24 hours**	
Precautions	❖ **Adults 16-60 years →maximum daily dose: aminophylline 1139 mg/day (equivalent to theophylline 900 mg/day)** ❖ **Adults >60 years →maximum daily dose: aminophylline 507 mg/day** ❖ **Patients currently receiving aminophylline or theophylline: A loading dose is not recommended without first obtaining a serum theophylline concentration .**	

Amiodrone

Strength		**150 mg/Amp**	
Compatibility		**D5W**	
Uses		**Dose**	**Infusion rate**
	AF cardioversion	**Loading**: 5–7 mg/kg IV over 30–60 minutes, then 1.2–1.8 g/day continuous IV **OR** divided oral doses until 10 g. **Maintenance**:- 200–400 mg/day PO -100 mg/day for the elderly or low body mass	**3 amp *250 ml →over 30-60min Then then 1.2–1.8 g/ day continuous IV or divided oral doses until 10 g**
	AF rate control (unlabeled)	300 mg over 1 hr then 10-50mg/hr over 24 hrs. Followed by 100-200mg/day as maintainence	**2 amp*150 ml →over 1hr Then 6 amp*500ml → 5.5 ml-27ml /hr. for 24 hr.**
	Stable VT or SVT	**First 24 hours**: 1050 mg according to following regimen :- -150 mg *100ml D5W over first 10 minutes. -Then 360 mg *200ml D5W over next 6 hours =1 mg/minute -Then 540 mg *300ml D5W over next 18 hours = 0.5 mg/minute -Then 800mg /day for 1 month then **Maintenance for VT**: 400 mg/day	**1 amp*100ml →over 10 min Then 6 amp*500ml → 34 ml/hr for 6 hrs Then 17 ml /hr for 18 hrs**
Stability		• **24 hr**	
Precautions		❖ **High drug concentration > 3mg/ml associated with vein phlebitis.** ❖ **For infusion >1hr do not exceed 2mg/ml**	

Atracurium

Strength		**50 mg /5ml**	
Compatibility		**Stable in D_5W, D_5NS incompatible with LR variable: NS**	
Uses		**Dose**	**Infusion rate**
	ICU paralysis (eg, facilitate mechanical ventilation) in selected adequately sedated patients	Bolus of 0.4 - 0.5 mg/kg, followed by 0.24 - 1.2 mg/kg/hour	**amp*100ml → 70 ml bolus followed by 33 – 168 ml/hr**
Stability		• **24 hours**	
Precautions			

Dexmedetomidine (precedx)

Strength		200 mcg/2 mL	
Compatibility		D_5W, LR, NS	
Uses		**Dose**	**Infusion rate**
	Loading infusion	1 mcg/kg over 10 minutes	Amp *50ml→17 ml over 10 minutes
	Maintenance infusion	0.2 to 1.4 mcg/kg/hour	3.5 – 25 ml/hr
Stability		• 24 hours	
Precautions		❖ Use of infusions >24 hours has been associated with tolerance and tachyphylaxis and dose-related increase in adverse reactions. ❖ Use for >24 hours is not recommended by the manufacturer and if so you must withdraw it gradually	

Diazepam

Strength		**5 mg /ml amp is 2 ml**	
Compatibility		**Administer undiluted by slow IV push**	
Uses		**Dose**	**Infusion rate**
	Sedation	**Loading dose**: 5 to 10 mg; **Maintenance dose**: 0.03 to 0.1 mg/kg every 30 minutes to 6 hours	**Loading dose: 5 to 10 mg** **then 2-7 mg every 0.5-6hr**
	Status epilepticus	-0.15 mg/kg (up to 10 mg/dose) at rate of up to 5 mg/minute. -May repeat every 5 minutes	**Loading dose: 5 to 10 mg** **May repeat every 5 minutes**
Stability			
Precautions		❖ **Do not administer through small veins (eg, dorsum of hand/wrist)** ❖ **Rapid injection may cause respiratory depression or hypotension so administer < 5 mg / min**	

Dobutamine

Strength	**250 mg / 20 ml**		
Compatibility	**D5W, NS**		
Uses		**Dose**	**Infusion rate**
		2–20 mcg/kg/minute	**1 amp * 50 ml → 1.6 -17 ml/hr. ≈ (2-20 ml /hr.)**
Stability	• **24 hours**		
Precautions	❖ **Some literature state that maximum dose is 40mcg/kg/min** ❖ **But ACC/AHA and SCCM recommend maximum dose of 20mcg/kg/min**		

Dopamine

Strength		**200 mg /5ml**	
Compatibility		**D5W, NS**	
Uses		**Dose**	**Infusion rate**
		1 amp * 50 ml	
	Dopa dose	1-3mcg/kg/min	**1-3 ml/hr.**
	Beta dose	4- 10mcg/kg/min	**4 - 10.5 ml/hr.**
	Alpha dose	>10mcg/kg/min	**>10.5 ml/hr.**
Stability		• **24 hours** • **Protect from light, don't use if darker than slightly yellow**	
Precautions		❖ **Do not use low-dose dopamine for renal protection because evidence does not support this practice.** ❖ **doses >20 mcg/kg/minute may not have a beneficial effect on blood pressure and increase the risk of tachyarrhythmias.** ❖ **infusion may be increased by 1-4 ml at 10- to 30-minute intervals until optimal response is obtained.**	

Fentanyl

Strength		**50 mcg/ml amp=2ml**	
Compatibility		**D_5W, NS.**	
Uses		**Dose**	**Infusion rate**
	Intermittent dosing	0.35 to .5 mcg/kg IV every 0.5 to 1 hour	**amp *10ml NS → 3-4 ml over 2 min every 0.5 to 1 hour**
	Continuous infusion	0.7 to 10 mcg/kg/hr IV	**5 amp*50ml →6-84ml / hr**
Stability		• **24 hours**	
Precautions		❖ **May cause respiratory depression even when used as recommended so *monitor closely***	

Heparin

Strength		**5000 IU /amp**	
Compatibility		**NS**	
Uses		**Dose**	**Infusion rate**
	ACS	60 units/kg (maximum: 4000 units), then 12 units/kg/hour (maximum: 1000 units/hour)	**1 amp bolus then** **5 amp * 50ml NS→1.8 ml/hr.**
	VTE	80 units/kg (or alternatively 5000 units) I. then 18 units/kg/hour (or alternatively 1000 units/hour) OR SC 333 units/kg then 250 units/kg every 12 hours	**1 amp bolus then** **5 amp * 50ml NS→2.7 ml/hr.**
	Intermittent I.V. Anticoagulation	10,000 units, then 50-70 units/kg (5000-10,000 units) every 4-6 hours	**2 amp bolus then** **1-2 amp /4-6 hr**
Stability		• **24 hr.**	
Precautions		❖ **Slight yellow coloration does not affect potency**	

Ketamine

Strength		**50 mg/vial**	
Compatibility		**D_5W, NS**	
Uses		**Dose**	**Infusion rate**
	For sedation and analgesia (Micromedx)	0.2 to 0.75 mg/kg over 2 to 3 minutes, followed by continuous infusion of .3-1.2 mg/kg/hr.	**amp*50ml → 15-50 ml over 2 to 3 minutes then 20-84 ml/hr.** ***My dilute the amp in 25 ml in patients with fluid restrictions**
	Critically ill patients (as an adjunct to an opioid analgesic for non-neuropathic pain)	0.1 to 0.5 mg/kg bolus over 2 to 3 minutes; followed by a continuous infusion 0.05 to 0.4 **mg**/kg/**hour**	**amp*50ml NS→ 8 -35 ml over 2 to 3 minutes then 3- 28 ml/hr.**
	Procedural sedation/analgesia (off-label use)	1 to 2 mg/kg (usual adult dose: 100 mg) over 2 to 3 minutes; may administer incremental doses of 0.5 to 1 mg/kg every 5 to 15 minutes as needed	**2amp*100ml NS→ 70-100 ml over 2 to 3 minutes then** **may administer 40-80 ml every 5 to 15 minutes as needed**
Stability		• **24 hours**	
Precautions			

Lidocaine

Strength		**20 mg/ ml * 50ml = 1000mg**	
Compatibility		**D_5W**	
Uses		**Dose**	**Infusion rate**
	Stable VT (with a pulse)	1–1.5 mg/kg IVP repeat 0.5–0.75 mg/kg every 3–5 minutes (maximum 3 mg/kg) then 1–4 mg/minute (14-57 cg/kg/minute) as maintenance .	**3-5ml iv bolus , repeat 1.5-2.5 ml /3-5 min (max. 11 ml) then** **1 amp*250 ml →15-60 ml/hr.**
	Pulseless VT/VF conversion	1–1.5 mg/kg IVP over 3 min; repeat 0.5–0.75 mg/kg every 3–5 minutes (maximum 3 mg/kg)	**3-5ml iv bolus , repeat 1.5-2.5 ml /3-5 min (max. 11 ml)**
Stability		• **24 hours**	
Precautions		❖ **Reduce bolus dose to 0.5–0.75 mg/kg IVP If LVEF < 40%** ❖ **Reduce maintenance infusion in patients with CHF, shock, or hepatic disease→ initiate infusion at 10 mcg/kg/minute (maximum dose: 1.5 mg/minute or 20 mcg/kg/minute).** ❖ **DO not give IV infusion Lidocaine at conc > 4 mg/ml *except* for fluid restriction can give up to 8 mg/ml.** ❖ **IV bolus can be given undiluted.** ❖ **Too rabid infusion can cause seizures.**	

Levosimendan

Strength		**25 mg/10ml**	
Compatibility		**D5W**	
Uses **ADHF - Septic shock - CCB toxicity**		**Dose**	**Infusion rate**
	Loading dose	6-12 mcg/kg over 10 minutes	**1 amp *500 ml → 8.5-17 ml over 10 min.** ***NB: 1 ml=50mcg**
	Maintenance dose	0.05-0.2 mcg/kg/minute (for 24 hr as a recommended duration)	**1 amp *500 ml →4.2 – 17 ml/hr.**
Stability		• **24 hr. in refrigerator**	
Precautions		❖ **<u>Should not</u> be used in pt with severe hypotension ,tachycardia or with mechanical obstruction affecting ventricular filling or outflow.** ❖ **<u>Avoid</u> in pt with severe renal or hepatic impairment and pt with history of torsade de point.**	

Midazolam

Strength		**5 mg /ml (2 ml)**	
Compatibility		**D_5W, NS** **incompatible with LR.**	
Uses		**Dose**	**Infusion rate**
	Sedation	**Initial dose**: 0.5 to 4 mg repeat at 5- to 15-minute intervals until adequate sedation achieved. **maintenance infusion**: 0.02 to 0.1 mg/kg/**hour** OR Start at 1 mg/hour and titrate to goal.	**Initial dose: 0.5 to 4 mg over 2 min then** **5 amp *50ml→1.4 ml to 7 ml /hr**
	Status epilepticus	IM: 10 mg once Preferred for ***intramuscular*** administration	
	Refractory Status epilepticus	**Loading dose:** 0.2 mg/kg then **Continuous infusion**: 0.05 to 2 mg/kg/hour **Titrated to** cessation of seizures **If breakthrough** while on the continuous infusion, administer a bolus of 0.1 to 0.2 mg/kg and increase infusion rate by 0.05 to 0.1 mg/kg/hour	**1 amp bolus over 5 min. then** **5 amp *50ml→3.5 ml – 140 ml /hr.**
Stability		• **24 hours .**	
Precautions		❖ **Withdraw gradually to prevent recurrent status epilepticus.**	

Milrinone (Primacor)

Strength		**10 mg /10ml**	
Compatibility		**D5W, NS**	
Uses		**Dose**	**Infusion rate**
	Loading dose	50 mcg/kg over 10 min	**1 amp * 50 ml →17.5 ml over 10 min**
	Maintenance dose	0.375-0.75 mcg/kg/minute	**1 amp * 50 ml →7.5 – 15 ml/hr** **NB: 1ml=200mcg**
Stability		• **Stable for 72 hr at room temp in normal light**	
Precautions		❖ **Use lower doses in renal failure** ❖ **Cause Vasodilation and hypotension, arrhythmias so Loading doses often omitted especially if patient hypotensive**	

Morphine

Strength		**10 mg /ml , amp=2ml**	
Compatibility		**D_5W, NS**	
Uses		**Dose**	**Infusion rate**
	Intermittent dosing	0.01 to 0.15 mg/kg IV every 1 to 2 hours NB:- in MI repeat dose every 5 to 15 minutes as needed	**amp*20ml NS →1-10ml over 4 to 5 min.** **every 1-2hr or 5-15min in MI**
	Continuous infusion	0.07 to 0.5 mg/kg/hr IV	**5amp*100→5-35ml/hr.**
Stability		• **24 hours**	
Precautions			

Nitrogylcerine

Strength	**50 mg/50ml**	
Compatibility	**D5W**	
Uses	**Dose**	**Infusion rate**
	5- 200 mcg/minute (increase by 5 mcg/minute every 5 min) *Typical dose in HF 25–75 mcg/minute	**10 ml thick + 40ml →1.5 – 60 ml** **1ml=200mcg**
Stability	• **24 hr.**	
Precautions	❖ **venous vasodilator> arterial vasodilator** ❖ **arterial vasodilation at high doses(e.g., 100 mcg/minute)** ❖ **tachyphylaxis occur within 24-48hr so give nitrate *free interval* (10-12 hr /day)**	

Nitroprusside

Strength	**50 mg/2ml**		
Compatibility	**D5W**		
Uses		**Dose**	**Infusion rate**
		0.2 - 10 mcg/kg/minute **NB**: Doses >5 mcg/kg/minute are not recommended	**50 mg*250 ml D5W → 4.2 – 210 ml/hr.**
Stability	• **Solution of nitroprusside may be light brown , light orange → use it if clear** • **While blue ,green, dark red or solution with particulate → not use as this indicate decomposition** • **Prepare it away from light** • **Prepared solution should be wrapped immediately with aluminum foil or other opaque material to protect from light and use within 24 hr**		
Precautions	❖ **Can cause cyanide or thiocyanate toxicity so use with caution in hepatic or renal impairment** ❖ **When administered in doses >3 mcg/kg/minute for prolonged periods of time (eg, 3-4 days), thiocyanate levels should be monitored daily** ❖ **Doses >5 mcg/kg/minutegive minimal added benefit and increased risk for thiocyanate toxicity** ❖ **Solution must be further diluted with 5% dextrose in water.** ❖ **Do not administer by direct injection.**		

Noradrenaline

Strength	**8 mg / 4ml**		
Compatibility	**D5W**		
Uses		**Dose**	**Infusion rate**
		0.01–3 mcg/kg/minute	**1 amp * 50 ml →.25 - 80 ml /hr.**
Stability	• **24 hr.** • **keep away from light ,don't use if brown coloration (oxidized),** • **not stable with sodium bicarbonate**		
Precautions			

Phenytoin

Strength		**250 mg**	
Compatibility		**NS**	
Uses		**Dose**	**Infusion rate**
	Status epilepticus	**loading** :- 15-20 mg /kg then 100/6-8hr by rate of 30-50ml/min	**Loading:-** **4 -5.5 amp *200 ml NS over 35 min** **Then 100 mg/6-8 hr. over 3 min.**
Stability		❖ **Use within 4 hrs.** ❖ **not refrigerate**	
Precautions		❖ **Inject into a large peripheral or central vein through a large-gauge IV catheter.** ❖ **Flush line with sterile saline before and following each IV injection to avoid local venous irritation caused by alkalinity of solution** ❖ **Elderly and pt with CV diseases should receive it more slowly.**	

Propofol

Strength		**20 mg/ml (2%)**	
Compatibility		• **Does not need to be diluted** **If needed may be further diluted in 5% dextrose to a concentration of ≥2 mg/mL.**	
Uses		**Dose**	**Infusion rate**
	sedation	0.3 mg/kg/**hour** Increase by 0.3 mg/kg/**hour** every 5 min. until desired sedation level **Usual maintenance** 0.3 to 3 mg/kg/**hour**	**0.7 ml/hr →10.5 ml/hr**
	Refractory Status epilepticus	**Loading dose:** 1 to 2 mg/kg with initiation of a continuous infusion of 1.2 mg/kg/**hour** **If breakthrough** occur increase infusion rate by 0.3 to 0.6 mg/kg/**hour** every 5 minutes **Dosage range** 1.8 to 12 mg/kg/**hour** (30 to 200 mcg/kg/minute) Withdraw gradually to prevent recurrent status epilepticus.	**Loading dose:** **3.5 – 7 ml bolus over 5 min** **Then 4.2 ml/hr.** **Increase infusion rate by 0.7-1.5 ml /hr. every 5 minutes** **Dosage range** **6 – 42 ml/hr.**
Stability		• **If transferred to a syringe or other container prior to administration, use within 6 hours.** • **If diluted in 5% dextrose stable for 8 hours at room temperature**	
Precautions		❖ **Avoid rapid bolus injection** ❖ **Shake well before use. Do not use if there is evidence of separation of phases of emulsion.** ❖ **Do not administer through the same IV catheter with blood or plasma.** ❖ **Tubing of propofol should be discarded after 12 hours.**	

streptokinase

Strength		**1.5 million units**	
Compatibility		**D5W - NS**	
Uses		**Dose**	**Infusion rate**
	STEMI	1.5 million unit over 1 hr	**1.5 million unit * 50ml →over 1 hr**
	PE	250,000 U over 30 min then 100,000 U /hr for 24 – 72 hrs	**1.5 million unit * 50 ml and give 8 ml over 30min then 3.3 ml/hr for 24-72 hrs**
Stability		• **Reconstituted solutions should be refrigerated and are stable for 24 hours** • **At room temp recommend use within 8 hours**	
Precautions		❖ **Special precautions during preparation**	

Thiopental

Strength			**500 mg**	
Compatibility			**D_5W, NS**	
Uses			**Dose**	**Infusion rate**
	General anesthesia	induction	3 to 4 mg/kg IV divided in 2 doses (maximum total dose 500 mg)	**amp*50ml→ 20-30 ml divided in 2 doses over 15 sec**
		maintenance	25 to 50 mg IV repeated as needed OR continuous IV infusion of 0.2% or 0.4% solution	**amp*50ml→3-5ml repeated as needed OR amp*150ml →continuous IV infusion**
	Increased intracranial pressure		1.5 to 3.5 mg/kg intermittent bolus IV injection as needed	**amp*50ml→10-25 ml bolus over 30 sec as needed**
	Seizure		75 to 125 mg IV, single dose; for local anesthetic-induced convulsion, 125 to 250 mg IV over 10 min	**amp*50ml→7.5-12.5 ml, single dose**
Stability			• **24 hrs**	
Precautions			❖ **it is advisable to inject a small test dose of 25 to 75 mg (1 to 3 mL of a 2.5% solution) to assess tolerance or unusual sensitivity** ❖ **only clear reconstituted solutions should be administered**	

References

- ✓ www.micromedexsolutions.com.
- ✓ online.lexi.com.
- ✓ Young, P. *(*2013). *Wellington ICU Drug Manual.* Wellington, New Zealand .
- ✓ Trissel, L.A. (2013). *Handbook on injectable drugs*. Wisconsin Avenue, Bethesda : American Society of Health-System Pharmacists.
- ✓ Gray,A. et al.(2011). *Injectable drugs guide*. London, UK : Pharmaceutical Press.
- ✓ Schull, P.D. (2009). *I.V. drug handbook.* USA : The McGraw-Hill Companies.

Notes

- All infusion rates are based on body wt. =70kg
- Clinical responsibility remains with the prescribing doctor.

☺ **For any Suggestions , please don't hesitate to contact at**

asmaa.ghourab@gmail.com